Novel Application for Translucent CMOS Sensors - Sensor-Embedded Optical Lenses for Omni-Focal Capacity

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Introduction

Ibid. previous publication concerning the use of a translucent CMOS layer upon a single-to-multi mode effect prism (i.e. a LiDAR prism,) translucent CMOS has the potential to revolutionize optics in more ways than one. In the case of that publication, it was postulated that resolution may be enhanced by taking two measurements of incoming light, one of which is prior to transmogrification by the prism and one subsequent to it. Without needing to further miniaturize the CMOS nodes themselves, this approach would enable one to deduce upon which part of a relatively coarse CMOS node a lightwave must have struck based upon the precise manner in which the frequency of the incoming light changed between the time between measurement #1 and measurement #2. This was an example of a resolution-enhancement application.

Aside from the ever-present goal of resolution-enhancement, another longstanding challenge in optics has been to find a mechanism that would enable for the simultaneous focus upon all points in the depth of field. In February 2021, metamaterial lenses were developed by MIT scientists which can shift parallax when heated. This, however, is, like a conventional lens system, not a true omni-focal system as metamaterial focal lenses take some length of time to shift their parallax and in the case where multiple pre-calibrated sections are used, resolution suffers as a result.

Ideally, an omni-focal optics platform should capture all photons regardless of angular momentum from one moment in time to the next and retain information both concerning their angular momentum as well as amplitude and frequency.

Abstract

Translucent CMOS sensors can be layered within a conventional optical lens so that lens and sensor may become one in the same. A standard lens operates by scattering light with angular momentum (relative to the position upon the lens where light enters) that is associated with points in the depth of field other than those one might wish to focus upon. Thus, if it were possible to incorporate multiple CMOS layers upon one another throughout the thickness of a thicker-than-usual traditional lens and those sensor nodes were translucent, measurements could be taken of light in both the presence and absence of light with varying values of angular momentum.

In the rear-most CMOS layer in such a system, only light arriving at the sensor layer with precisely perpendicular angular momentum would successfully arrive

at that particular layer as it would have, by that point, been redirected by the lens. As one moves toward the front of this sensor-infused lens, light would be captured including both the light with zero parallelism as well as light including "some" parallelism. The image generated from the rear-most layer would be equivalent to "infinite focal distance" and would be used as a basis for algorithmic comparison with the image generated by the sensor layer just forward of that sensor layer. The color and luminosity values associated with the image generated by the rear-most layer would be subtracted from the overall impression made upon the "forward" sensor layer. The algorithmically-generated meta image associated with that layer would be used as the basis extrapolating the third, and so on.

What remains would define the focused image of whatever it is one is trying to photograph somewhat nearer to the observer than the infinite focal distance. Something like 50 layers might be incorporated so that a reasonable variety of images could be generated that describe objects at a plethora of specific ranges from the sensor-lens.

Each digital "exposure" in such a scheme would result in the generation of 50 or perhaps more discrete images each of which are temporally synchronized but which describe objects at a wide variety of focal distances. All that would be required to realize this feat would be the design of appropriate transparent optical sensing materials and the development of a relatively simple extrapolative algorithm.

Conclusion

Wherever high-quality, high-speed photography is called for, particularly where range is difficult to judge, omni-focal imaging is destined to provide a solution to one of the longest-standing challenges in optics faced by engineers today.